APPENDIX A

DESIGN APPENDIX
MILWAUKEE, WISCONSIN
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

U.S. ARMY CORPS OF ENGINEERS

DETROIT DISTRICT

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1. INTRODUCTION

1.1. PURPOSE AND SCOPE OF STUDY. The purpose of this appendix is to present detailed engineering and design data for the Milwaukee, Wisconsin Dredged Material Disposal Facility (DMDF) project. This appendix provides the basis for the preparation of plans and specifications for construction of the DMDF. Description of procedures and basic supporting data related to investigations made in connection with the preparation of this appendix are presented in the paragraphs and figures to follow. This engineering and design is being accomplished under the National Harbors Program: Dredged Materials Management Plan (DMMP).

1.2. BACKGROUND. The existing Milwaukee Confined Disposal Facility (CDF) was constructed in 1973. The north and east sides are stone rubble mound dikes with a grout filled mattress on the interior slope extending from the top to 1.0' above Low Water Datum. The south wall consists of steel sheet pile cells and the west side is a steel sheet pile bulkhead. Two circular filter cells are located in the north dike. The area enclosed is approximately 54 acres.

In 2003 the southern portion, approximately 14 acres, of the CDF was returned to the local sponsor for development. The remaining 40 acre site is near capacity with 70,000 cubic yards (cy) of maintenance dredging in 2007 and an expected 176,000 cubic yards (cy) of permit dredging disposal in 2008.

To continue maintenance of the harbor additional capacity is required. Three alternatives were considered including expansion of the facility to the north, open water disposal and upward expansion by construction of interior dikes. Economic and environmental factors and the input of the local stakeholders determined the upward expansion is the preferred alternative. This appendix details the upward expansion of the facility.

1.3. DATA COLLECTION. The design data collected during the course of this study has included the following:

a. CADD drawings developed from topographic surveys provided by the Technical Support Section, Detroit District Corps of Engineers used for the plan layout and volume computations.
b. Soil boring investigations by STS Consultants in August 2006 and soil boring investigations by Coleman Engineering Company in July 1995 and October 1997 used to provide data for a stability analysis of the proposed dikes and estimate the long term settlement.
c. All soundings and elevations are referenced to Low Water Datum (L.W.D.) for Lake Michigan, 577.5 feet above Mean Sea Level at Rimouski, Quebec. International Great Lakes Datum (I.G.L.D.) 1985.

2. DESIGN

2.1. DESIGN CRITERIA. The design rationale used in this study provides for an efficient least cost plan based on sound engineering practice with proper consideration given to environmental and social aspects. The following parameters were assumed:

- Estimates of the 20 year capacity requirements of the DMDF include 350,000cy of maintenance dredging and 70,000cy of permit dredging. In addition approximately 130,000cy of backlog dredging currently exist.
- Capacity will be attained by constructing new interior dikes from on-site materials.
- Dredging and conveyance into the site will be performed by mechanical equipment. The limited area available for containment will not permit the storage of the high volume of water associated with the hydraulic transport of dredged material. The Corps does not have a permit to discharge from the existing Confined Disposal Facility (CDF). Discharge from the existing filter cells would require water quality certification from the Wisconsin Department of Natural Resources (WDNR). Access to the filter cells from the DMDF is not included in the design.
- The water in the DMDF will be controlled by evaporative dewatering. Trenching and spreading will speed the evaporative process. This method has proved effective with the existing CDF.
- The local stakeholders have limited the top elevation of the interior dikes to +18 feet above L.W.D.
- It is assumed that bulking and consolidation will be the same.

2.2. PROJECT FEATURES. Milwaukee Harbor is located on the west shore of Lake Michigan in the City of Milwaukee, Wisconsin which is about 85 miles north of Chicago, Illinois, and approximately 83 miles west of Grand Haven, Michigan.

Milwaukee Harbor is a deep draft harbor at the confluence of the Milwaukee River and the Kinnickinnic River.

The Milwaukee Dredged Material Disposal Facility (DMDF) is located in the outer harbor 6500 feet south of the entrance channel. The site is bounded by water on the north and east sides and access by land on the west side. A ferry terminal occupies the southern portion of the site. The Site Plan is shown on Figure 1.

The total area available for construction of additional dikes for dredged material placement is approximately 40 acres. The plan includes construction of dikes with a road on the crest inside the existing perimeter dikes, a Section A-A is shown on Figure 2. An off loading platform and mooring piles will be installed at the northeast corner for use in off loading activities, shown on Figure 4. A road and gate along the west side will provide land access to the off loading site.

The volume of materials to be dredged and placed in the DMDF during a particular dredging season will depend upon the degree of critical shoaling and the availability of dredging funds, however, it is estimated that average bi-annual maintenance dredging activities would be 35,000 cubic yards

The top elevation of new dikes would be 8 feet above the top elevation of existing perimeter dikes. Materials for new dike construction would be obtained from borrow areas located within the site. Drainage within the cell would be maintained by construction of new ditches or improvements to existing ditches.

The interior dikes will be constructed to a slope of 1V:3H. All interior dikes will have a minimum fifteen foot (15.0 ft.) top width to accommodate a crushed aggregate road. Typical sections are shown on Figure 3. Radius will be constructed at the corner of the cell to allow for vehicle turn around and dumping. It is envisioned that material will be off loaded from scows into trucks with excavation equipment, transported and dumped into the cell. Chutes or conveyors could also be used to transport and distribute the material into the cell. Low ground pressure equipment would be needed to spread the dredged material to facilitate drying. Placement into the confined area would be controlled so as to preclude erosion of the interior dike slope.

2.3. SITE DESIGN. The design of the DMDF is limited by the relatively small area available for confinement. The construction of the dikes will be completed in phases. The permit dredging scheduled for 2008 will be required to construct a cell for placement. The cell will be constructed by excavating the west portion of the existing CDF to +1.0 feet above L.W.D. The excavated material will be placed in 1.0 foot lifts around the perimeter of the site to an elevation of +10.0 feet above L.W.D. and compacted to 90% of the maximum dry density.

The footprint of the new interior dike will be graded to an elevation of +10.0 feet. The marginal quality of the material within the existing CDF requires foundation reinforcement for the new interior dikes. Portland cement, at 5% volume dry weight, will be mixed with the top one foot of the foundation material and compacted. This will be sufficient to reduce plasticity and improve bearing strength.

The interior dikes will be constructed from material excavated from the CDF. The material will be placed in 1.0 foot lifts and compacted to 90% maximum dry density. The interior and exterior slopes will be constructed to 1V: 3H. The volume of material required to construct the dikes is based on the assumption the construction of the permit dredging cell will precede the dike construction. The excavation of the cell will provide sufficient material to fill the footprint of the dike to an elevation of +10 feet. The volume of material shown in Figure 5 was calculated using Microstation Inroads software for fill above +10 feet.

The distance from the outside of the existing perimeter dikes to inside the new cell, approximately 100', precludes direct deposition into the cell. A 1 foot thick crushed aggregate road with a geotextile underlayment will be constructed on top of the new dikes. The quantities calculated used the Inroads software to determine the square footage of the top surface of the berms including the radius. The exterior of the berms on the north and east sides will be protected by 200lb – 500lb splash stone. A woven geotextile will be placed underneath the splash stone for filtration and drainage.

In the dredging and disposal cycle, assuming 35,000 cubic yards of materials are removed will result in a 1' thick layer of material spread throughout the placement area to facilitate drying and consolidation. The total area available for fill was calculated using Inroads. A digital terrain model was created assuming the entire area designated for permit dredging is filled to +10 feet. The borrow area was modeled excavated to +2 feet providing sufficient material to construct the berms. A top surface was created intersecting the dikes at +17 feet with a 1% grade to the middle of the new cell. A volume of approximately 500,000cy was calculated between the two surfaces, shown in figure 6. A settlement analysis is included in the Geotechnical Data Attachment A. Settlement was not included in the available volume assuming this volume will be used for a final cover and landscaping when the site is filled.

A stability analysis of the proposed new berm configuration was undertaken in order to assure its integrity under conditions of deposition into the site. Data for the analyses was derived from soil borings taken within the proposed placement area as shown in the Geotechnical Data Attachment A. The borings indicate that the soils in the CDF are primarily high and low plasticity silty/sandy clays (CL and CH) with trace organics. A soil profile of the placement area is shown in the Geotechnical Data Attachment A.

The stability analysis as detailed in the Geotechnical Data Attachment A provides a check to determine the stability of the dikes against sliding. The results of the analysis verify that the proposed dimensions for side slopes of 1V:3H will provide a sound structure.

REFERENCES

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